Stakeholder Participation and Contests: A Tullock Inspired Comment

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Abstract

Stakeholder engagement surrounding a binary decision is examined using a Tullock (1980) style contest success function. Increasing the effectiveness of contestant effort can increase effort provided, with little change in success probabilities, and a net loss in welfare. When the contest prize is a private good for some contestants and a public good others, free riding benefits the private good party. Preferentially engaging the public good enjoying contestants is more likely to increase welfare than engaging all equally. Varying combinations of contestant effort effectiveness may reveal information about the value of the public good, and can also equalize expected payoffs.

1 Introduction

Stakeholder consultation, collaborative management, and a host of other forms of participatory decision-making are in vogue. The essence is that those affected by a government investment or regulatory change are to be consulted, and their input used to shape the policy. In so doing, the resulting decision will in some sense be better than absent such consultation. This paper focuses on a particular class of such situations, where the government decision is binary. Examples include permitting development projects or allowing firms to undertake particular activities. Typically, the proponents stand to make a private financial gain, while the opponents expect to suffer the loss of a public good.

There is a considerable literature promoting the virtues of participation, engagement, community involvement, etc., with relatively little critical appraisal. Ambiguity characterizes the results of the limited analysis. Where participants are asked to assess the value to them of the experience - increasing trust, understanding, etc., results are generally positive (e.g. Beierle and Konisky, 2000). However, as noted by Irvin and Stansbury (2004), the role of economic incentives is often overlooked. These may include spending external funds (Leach et al., 2002) and avoiding externally imposed solutions (Margerum and Whitall, 2004). Ironically, engagement in stakeholder forums may convince participants that someone else will address the problem, reducing own effort (Lubell, 2004).

This note employs a Tullock (1967, 1980) style contest to examine how changing the effectiveness of contestant effort impacts on that effort and contest outcomes. Where Katz et al. (1990) examine two public good enjoying communities, this note examines one group that enjoys a public good while a second splits a private gain. Our situation is like Graichen et al. (2001), where a firm faces an environmental lobby. Like Graichen et al., we consider an effect akin to the strength of the environmental lobby. However, we also consider voluntary contribution of contestant effort. It is found that in many situations, making it easier for stakeholders to become involved in the decision-making process simply leads to more effort, but little change in the outcome. However, judicious manipulation of effort effectiveness may be used to reveal information about the value of the public good, and may also be a tool for enhancing equity.

2 Model

Two players, a project proponent (developers) and opponent (households), are engaged in a contest with the probability of success for the proponent given by

$$p(x_1, x_2) = \frac{(\alpha_1 x_1 + \beta_1)^r}{(\alpha_1 x_1 + \beta_1)^r + (\alpha_2 x_2 + \beta_2)^r}$$

where x_1 and x_2 are contestant effort levels, $\alpha_1, \alpha_2 > 0$ measure the effectiveness of contestant effort, and $\beta_1, \beta_2 \geq 0$ capture regulator bias. If $\beta_1 = \beta_2 = 0$, define $p(0,0) = 0.5$. The scale parameter r must be positive. Skaperdas (1996) and Kooreman and Schoonbeek (1997) develop axiomatic justifications for the basic Tullock form ($\alpha_k = 1$ and $\beta_k = 0$, $k = 1,2$). The effectiveness here represented by α_1 and α_2 is similar to the bias introduced by Leininger (1993) and the productivity parameter used by Graichen et al. (2001). When at least one $\beta_i > 0$, the non-existence of a zero effort equilibrium noted by Hirshleifer (1989) is no longer an issue.

2.1 Optimizing Representative

Consider first the case where one representative for m development firms and another for n households control effort. With contest success, developers earn an expected benefit of B/m, while if households win, they each earn public good value G. Representatives care about aggregate welfare for their group, yielding expected payoff functions

$$V_1(x_1, x_2) = m[p(x_1, x_2)B/m] - x_1 \tag{1}$$

$$V_2(x_1, x_2) = n[1 - p(x_1, x_2)]G - x_2 \tag{2}$$

A regulator concerned about expected social welfare will only be indifferent when $nG = B$. It is assumed that, due to information or other constraints, the regulator's choice is probabilistic in the sense of a Tullock contest.

We follow the solution approach of Nti (1999) and others, calculating the first order conditions and using these to establish the relationship between contestant effort levels. This generates the equilibrium relationship

$$\frac{x_2 + \beta_2/\alpha_2}{nG} = \frac{x_1 + \beta_1/\alpha_1}{B} \tag{3}$$

which is consistent with Nti (1999); contestant effort does not depend on the scale term r. It does depend on β_k/α_k, the *effective* gift implied by the regulator's bias.

Using equation 3 and the first order conditions, equilibrium contestant effort when chosen by group representatives is

$$x_1^* = \frac{Br(\alpha_2 nG/\alpha_1 B)^r}{[1 + (\alpha_2 nG/\alpha_1 B)^r]^2} - \frac{\beta_1}{\alpha_1} = B\Theta^R - \frac{\beta_1}{\alpha_1} \tag{4}$$

$$x_2^* = \frac{nGr(\alpha_1 B/\alpha_2 nG)^r}{[1 + (\alpha_1 B/\alpha_2 nG)^r]^2} - \frac{\beta_2}{\alpha_2} = nG\Theta^R - \frac{\beta_2}{\alpha_2} \tag{5}$$

with $\Theta^R = r(\alpha_2 nG/\alpha_1 B)^r/[1+(\alpha_2 nG/\alpha_1 B)^r]^2$ and R indicating representatives chose. Setting $B = V_1$, $nG = V_2$, $\alpha_k = 1$ and $\beta_k = 0$ reproduces the typical non-cooperative Nash equilibrium (see for example Linster, 1994; Nti, 1999). In particular, when $V_1 = V_2 = V$, each representative chooses $x_i = rV/4$. Total contestant effort is maximized when $\alpha_2 nG = \alpha_1 B$, which is when Θ attains its maximum of 1/4. At the optimum, success probability is

$$p(x_1^*, x_2^*) = \frac{(\alpha_1 B)^r}{(\alpha_1 B)^r + (\alpha_2 nG)^r} \tag{6}$$

depending only on the effective value of the outcome payoffs. The regulator's gift is exactly offset. Also notice that since the representatives are concerned with aggregate expected benefit, only the number of households affects equilibrium effort and success probability. The number of firms does not matter.

Manipulating α_k and β_k can generate corner solutions. For large enough β_k - strong regulator bias - one or both representatives will choose $x_k = 0$. Changing α_k changes $(\alpha_1 B/\alpha_2 nG)^r$, which can drive one contestant's effort to zero. If one contestant is effective enough, it is not worthwhile for the other to compete. Notice that with $\beta_k > 0$, contestant effort may be positive even absent opponent effort. For the x_1 player, the objective becomes

$$\max_{x_1} \left[B\frac{(\alpha_1 x_1 + \beta_1)^r}{(\alpha_1 x_1 + \beta_1)^r + \beta_2^r} - x_1 \right] \tag{7}$$

with $x_1 \geq 0$. When $B\beta_1^{r-1}\beta_2^r > (\beta_1^r + \beta_2^r)^2$, it is expected benefit maximizing to choose $x_1 > 0$.

An obvious result from equations 4 and 5 is that the regulator's bias substitutes for own effective effort. Of particular importance is the fact that if β_1 and β_2 are reduced together - the regulator reducing the strength of their prior bias - the response is for both contestants to increase their effort, with no change in the success probability (equation 6). If decreasing β_k does not itself reduce costs, then this change is necessarily welfare reducing.

The impact of changes in α_k, effectiveness, on x_k^* is

$$\begin{bmatrix} \frac{\partial x_1^*}{\partial \alpha_1} & \frac{\partial x_1^*}{\partial \alpha_2} \\ \frac{\partial x_2^*}{\partial \alpha_1} & \frac{\partial x_2^*}{\partial \alpha_2} \end{bmatrix} = \begin{bmatrix} \frac{\beta_1}{\alpha_1^2} + \frac{B}{\alpha_1}\Psi^R & -\frac{B}{\alpha_2}\Psi^R \\ \frac{nG}{\alpha_1}\Psi^R & \frac{\beta_2}{\alpha_2^2} - \frac{nG}{\alpha_2}\Psi^R \end{bmatrix} \tag{8}$$

where

$$\Psi^R = \frac{r^2(\alpha_2 nG/\alpha_1 B)^r[(\alpha_2 nG/\alpha_1 B)^r - 1]}{[1+(\alpha_2 nG/\alpha_1 B)^r]^3} \tag{9}$$

Ψ^R also equals $(1/\alpha_1)\partial\Theta^R/\partial\alpha_1$ and $(-1/\alpha_2)\partial\Theta^R/\partial\alpha_2$. Notice that $\Psi^R = 0$ when $\alpha_2 nG = \alpha_1 B$, and $\Psi^R > 0$ when effective payoff is greater for the household group. Own effort is increasing in rival's effectiveness when own position is favoured - strong enough to counter rival - and decreasing otherwise. Increasing α_k can encourage an effort contest or, for large enough α_k, lead to acquiescence. With $\Psi^R = 0$, any proportionate increase in effectiveness, $\Delta\alpha_1 = k\Delta\alpha_2$, results in an increase in total effort. Thus, making it easier for stakeholders to participate will increase participation. However, if it is both costly to make it easier to participate and stakeholder effort itself is costly, then such actions reduce welfare.

2.2 Voluntary Contribution

An extreme alternative to the representative case is all effort generated by voluntary contributions - the representative only collects contributions. The value functions for each agent type become

$$V_1(\boldsymbol{x}_1, \boldsymbol{x}_2) = p(\boldsymbol{x}_1, \boldsymbol{x}_2)(B/m) - x_{1i} \tag{10}$$

$$V_2(\boldsymbol{x}_1, \boldsymbol{x}_2) = [1 - p(\boldsymbol{x}_1, \boldsymbol{x}_2)]G - x_{2j} \tag{11}$$

where x_{1i} and x_{2j} are individual contributions, collected in the vectors $\boldsymbol{x}_1$ and $\boldsymbol{x}_2$. The contest success function becomes

$$p(\boldsymbol{x}_1, \boldsymbol{x}_2) = \frac{(\alpha_1 \sum x_{1i} + \beta_1)^r}{(\alpha_1 \sum x_{1i} + \beta_1)^r + (\alpha_2 \sum x_{2j} + \beta_2)^r} \tag{12}$$

The resulting equilibrium (with $x_1^* = m x_{1i}^* = \sum x_{1i}^*$ and $x_2^* = n x_{2j}^* = \sum x_{2j}^*$) has

$$x_1^* = \frac{r(B/m)(\alpha_2 mG/\alpha_1 B)^r}{[1 + (\alpha_2 mG/\alpha_1 B)^r]^2} - \frac{\beta_1}{\alpha_1} = \frac{B\Theta^V}{m} - \frac{\beta_1}{\alpha_1} \tag{13}$$

$$x_2^* = \frac{rG(\alpha_1 B/\alpha_2 mG)^r}{[1 + (\alpha_1 B/\alpha_2 mG)^r]^2} - \frac{\beta_2}{\alpha_2} = G\Theta^V - \frac{\beta_2}{\alpha_2} \tag{14}$$

where $\Theta^V = r(\alpha_1 B/\alpha_2 mG)^r/[1 + (\alpha_1 B/\alpha_2 mG)^r]^2$, and V indicating voluntary contribution. Effort is now maximized when $\alpha_1 B/m = \alpha_2 G$, effective per firm profit equals the effective individual value of the public good. Equilibrium contest success becomes

$$p(x_1^*, x_2^*) = \frac{(\alpha_1 B/m)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r}$$

As in Katz et al. (1990), free riding makes total household contribution independent of the number of households, and reduces total developer contribution with more firms. More firms reduces the industry success rate, while more households does not affect it.

The effect of changes in β_k carry through exactly as for the representation case. For changes in α_k, B/m

replaces B, G replaces nG, and the scaling term Ψ^R is replaced by Ψ^V, which is defined as

$$\Psi^V = \frac{r^2(\alpha_2 mG/\alpha_1 B)^r[(\alpha_2 mG/\alpha_1 B)^r - 1]}{[1+(\alpha_2 mG/\alpha_1 B)^r]^3} \tag{15}$$

Behaviour is now driven by per capita and per firm impacts, as opposed to aggregate impacts. Now, since normally $m \ll n$, G must be much larger than B, or α_2 much larger than α_1, before Ψ^V becomes positive (equation 14). Thus, with voluntary contributions in this game, industry effort will exceed household effort unless nG is much larger than B, or household effectiveness (α_2) is much greater than industry effectiveness. Alternatively, to encourage household participation, α_2 must be increased relative to α_1.

2.3 Social Welfare

Expected social welfare, assuming contestant effort lost, is

$$W = \left[\frac{(\alpha_1 B)^r}{(\alpha_1 B)^r + (\alpha_2 nG)^r}\right] B + \left[\frac{(\alpha_2 nG)^r}{(\alpha_1 B)^r + (\alpha_2 nG)^r}\right] nG - x_1^* - x_2^* \tag{16}$$

Since $\partial W/\partial \beta_k = 1/\alpha_k > 0$, it follows that increasing the strength of the regulator's bias increases social welfare, as contestant effort is reduced. In the limit, increasing β_1 and β_2 drives total contestant effort to zero, yielding a contest success probability $\beta_1^r/(\beta_1^r+\beta_2^r)$. This is efficient if β_1 and β_2 are chosen to always pick the welfare maximizing outcome. Thus, in this model, an omniscient Platonic dictator is the most efficient.

The total derivative of 16 is used to explore the impact of changes in α_k,

$$\left\{\frac{r}{\alpha_1}\Phi^R(B-nG) - \frac{\partial x_1^*}{\partial \alpha_1} - \frac{\partial x_2^*}{\partial \alpha_1}\right\} d\alpha_1 + \left\{\frac{r}{\alpha_2}\Phi^R(nG-B) - \frac{\partial x_1^*}{\partial \alpha_2} - \frac{\partial x_2^*}{\partial \alpha_2}\right\} d\alpha_2 \tag{17}$$

with

$$\Phi^R = \frac{(\alpha_1 B)^r(\alpha_2 nG)^r}{(\alpha_1 B)^r + (\alpha_2 nG)^r}$$

If $\alpha_1 B = \alpha_2 nG$, expected welfare cannot be increased by increasing α_1 or α_2. Only if outcomes and/or effectiveness are highly unbalanced, such that the gain in expected benefit from the outcome exceeds impacts of effort changes, can changing effectiveness increase welfare. Practically, the regulator must reach out to the under-represented party, rather than inviting all opinions.

With voluntary contributions, expected social welfare becomes

$$W = \left[\frac{(\alpha_1 B/m)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r}\right] B + \left[\frac{(\alpha_2 G)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r}\right] nG - x_1^* - x_2^* \tag{18}$$

The impact of changing β_k is unchanged. For changes in α_k the expression is as above (equation 17) with partials for the voluntary contribution case and Φ^R replaced by

$$\Phi^V = \frac{(\alpha_1 B/m)^r(\alpha_2 G)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r} \tag{19}$$

Once again, for interior solutions, welfare can only be increased for asymmetric changes in α_k which favour agents whose preferred outcome has the higher welfare. For corner solutions, this may not hold if α_k is increased enough to reduce effort by the contestant still exerting some.

When the regulator knows which of B or nG is larger, then contestant effort is wasted effort, and it is most efficient for the regulator to simply choose the best outcome. However, if the regulator does not know the values, then manipulating α_k can provide some information. When representatives choose x_k, effort is maximized when $\alpha_1 B = \alpha_2 nG$. Beginning with $\alpha_1 = \alpha_2$, if increasing α_2 increases total effort, then $nG < B$. When effort is voluntarily contributed, total effort is maximized when $\alpha_1 B/m = \alpha_2 G$, and household effort may be zero when $\alpha_1 = \alpha_2$. Zero household effort occurs when $G\Theta^V = \beta_2/\alpha_2$. Increasing α_2 on this threshold will induce positive household effort. Finding this threshold provides some insight on the size of G, while finding where total effort is maximized reveals the relation between $\alpha_1 B/m$ and $\alpha_2 G$. If the contests are repeated, then in expectation, payoffs for the groups can be equalized by choosing α_1 and α_2 such that

$$\left[\frac{(\alpha_1 B/m)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r}\right] B - x_1^* = \left[\frac{(\alpha_2 G)^r}{(\alpha_1 B/m)^r + (\alpha_2 G)^r}\right] nG - x_1^* \tag{20}$$

This may be a useful tool for achieving equity objectives when financial compensation via tax and transfer is either inappropriate or not possible.

3 Numerical Example

For illustration, consider a numerical example with $r = \beta_1 = \beta_2 = 1$, $n = 250$ and $B = 500$. Figure 1 illustrates three voluntary effort contribution cases and one representative chosen effort case. In the latter, household and industry effort contours are reflections around the $\alpha_1 B = \alpha_2 nG$ line. With voluntary effort contributions, household effort increases with the number of firms, as that effort is more effective when firms are free riding on each-other. When the value of the public good is increased, household effort increases, and the $x_2^* = 0$ threshold moves down. Notice that above the zero effort - households or firms - threshold, optimal effort for one agent is always positive, even if it is zero for the other. Notice also that total industry effort is often positive, even when household effort is zero.

[Figure 1 about here.]

In panel (a) of Figure 2, both the threshold ratio α_2/α_1 at which contest effort is first provided and the location of the maximum decreases as nG increases relative to B. This provides a possible mechanism for identifying how nG relates to B, varying α_2/α_1. The lower the ratio at the threshold, the larger nG. Likewise (note log scale for α_2/α_1), the larger nG, the larger the rate of increase in x_1^* and x_2^* in the neighbourhood of the threshold.

[Figure 2 about here.]

Absent tax and transfer options, if the game is repeated, the regulator can manipulate α_2/α_1 to equalize expected payoff. Figure 2, panel (b) shows how success probability for the firm declines as α_2/α_1 shifts to favour of households. When $nG = B$, the net loss in welfare is relatively small (see Table 1). The cost of equal expected payoff is much greater when outcomes are vastly different. This mechanism of achieving equity is only useful when outcomes are approximately equal. Otherwise, even very inefficient tax and transfer is likely less costly.

[Table 1 about here.]

4 Discussion

A linear transformation of effort in a Tullock contest provides a conceptual framework to explore the effects of inducing greater stakeholder participation. The stylized case is development of a block of land that provides a public good to households in its undeveloped state and profit to firms if developed. Where contest outcomes are nearly equal and contestant power is balanced, representatives selecting contest effort can end up in a prisoner's dilemma - both contributing high effort and resulting expected welfare the lowest. With voluntary contest effort contribution, overcoming the household free rider problem requires either that their preferred outcome generates sufficiently more welfare or that household effort is sufficiently more influential. With perfect information, expected welfare is maximized when the contest is avoided. In contrast, if outcome values are not known to the regulator, manipulating relative influence can reveal information about these values. If relative outcomes are close, it may be possible to use effort effectiveness to enhance equity.

A sequence of participation opportunities may be a practical way to use contestant effort as a measure of relative outcome values. When a development plan is first announced, no specific stakeholder engagement is sought. Any that does occur is a first indication. After some time, a toll free number or web site can be built to permit easier participation. If this encourages a large jump in stakeholder participation, the public good is likely quite valuable. This can be followed by meetings or forums located for easy attendance by those most affected. If this still fails to engage many stakeholders, the public good value is probably not that great. This pattern is not uncommon. However, it is not clear if it is followed as an information gathering tool.

Stakeholder engagement may serve other functions as well. When effort itself provides utility, facilitating effort can be a form of vote buying. This is particularly likely when perks - meals, travel, etc. - are provided to participants. It is also possible that engagement indirectly provides utility by changing the outcome values. Those affected may be more accepting of the outcome if they were part of the process.

5 Conclusion

Is stakeholder engagement just another contribution to climate change, a generator of hot air? A modified Tullock contest suggests that it may be little more than wasted effort. However, it may also serve as a tool for a regulator to measure relative outcome values. In some situations, it may also be a cost effective tool for pursuing equity objective. However, in both cases, engagement activities most likely need to favour stakeholders for whom the outcome is more like a public good.

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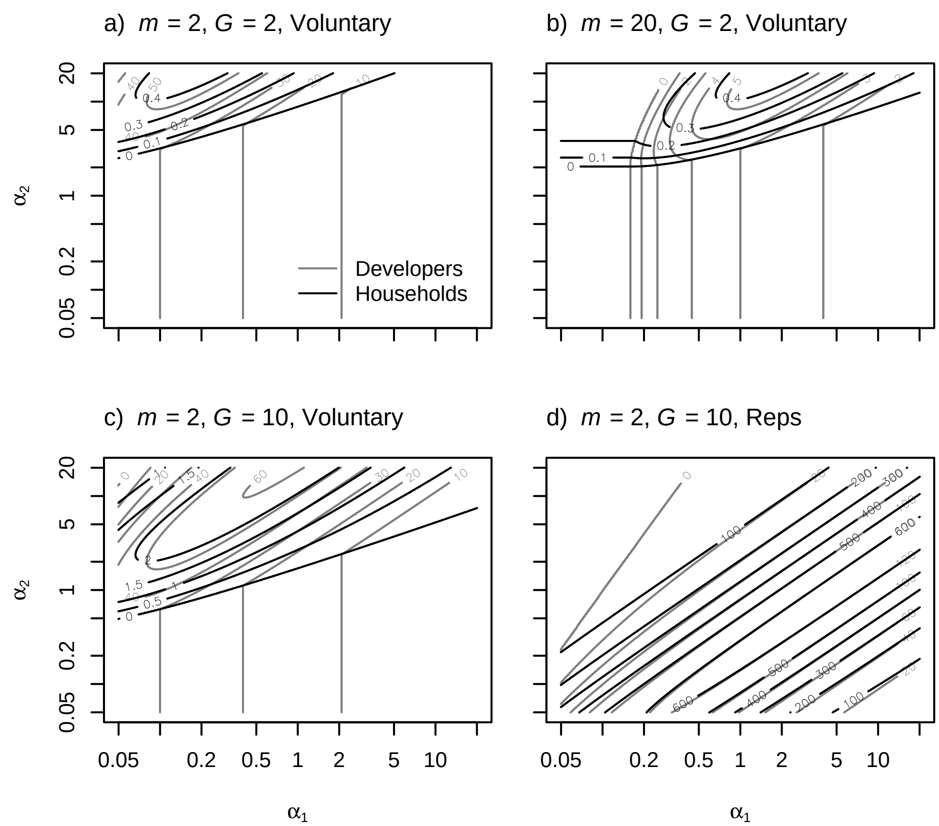

Figure 1: Impact of changing lobbying effectiveness on household and industry total contest effort for four cases. Effort is either provided voluntarily or chosen by representatives (Reps).

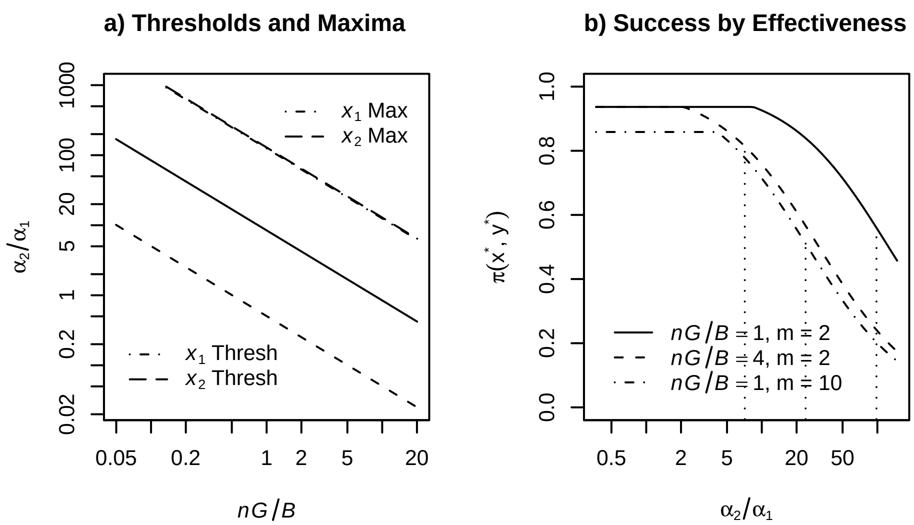

Figure 2: Relationship between relative prize size and effectiveness ratio at zero effort thresholds and maximum effort levels, and between effectiveness ratio and success probability. Vertical lines in panel (b) mark probability where expected net prize is equal for both groups. $B = 500$, $\alpha_1 = 1$, $m = 2$ and $n = 250$.

List of Tables

Table 1: Equal expected payoff points.

a_2	x_1^*	x_2^*	$\pi(x_1^*, x_2^*)$	$\frac{E(W)}{\max W}$
98.17	60.60	0.483	0.560	0.878
7.13	36.80	1.069	0.814	0.370
23.92	11.49	0.458	0.511	0.976